

M.Sc. GEOLOGY SYLLABUS

(Effective from June 2003)

M.Sc. Geology course of Two Years duration is divided into Four Semesters.

- * Each Semester is of 300 marks.
- * Each Semester will have Four Theory Papers, each of 50 marks.
- * Each Semester will have Four Practical Papers, related to four Theory Papers, each of 25 marks.

Teaching Work-load :

- * Each Theory Paper will have four lectures, each of 60 minutes duration, per week.
- * Each Practical Paper will have four lectures, each of 60 minutes duration, per week.

Geological Study - Tours/ Mine Training Programme/ Field Work

- * The students will have to undertake Geological Study- Tours/ Field Mapping Tours for at least eight days in Semester- II. This will be compulsory and carries marks. These marks will be included in the Practical.
- * The students will have to under go mine training programme/ On- site Training/ Engineering tours for at least 12 days in Semester - IV. This will be compulsory and will carry marks. These marks will be included in the Practical.
- * Regular Seminars and Tutorials based on each paper will be conducted in the Department from time to time. It is compulsory for every student.

SEMESTER I

Theory paper I : Mineralogy and Crystallography
Theory paper II : Igneous Petrology
Theory paper III : Metmorphic Petrology
Theory paper IV : Sedimentary Petrology

Practical paper I : Mineralogy and Crystallography
Practical paper II : Igneous Petrology
Practical paper III : Metmorphic Petrology
Practical paper IV : Sedimentary Petrology

SEMESTER II

Theory paper V : Stratigraphy and Palaeontology
Theory paper VI :Structural Geology and Tectonics
Theory paper VII : Remote Sensing and Geomorphology
Theory paper VIII : Ore Geology, Instrumentation and Analytical Techniques

Practical paper V : Stratigraphy and Palaeontology
Practical paper VI :Structural Geology and Tectonics
Practical paper VII : Remote Sensing and Geomorphology
Practical paper VIII : Ore Geology, Instrumentation and Analytical Techniques

SEMESTER III

Theory paper IX : Hydrogeology
Theory paper X : Fuel Geology
Theory paper XI : Geophysical Exploration
Theory paper XII : Environmental Geology

Practical paper IX : Hydrogeology
Practical paper X : Fuel Geology
Practical paper XI : Geophysical Exploration
Practical paper XII : Environmental Geology

SEMESTER IV

Theory paper XIII : Mining Geology
Theory paper XIV : Geochemistry
Theory paper XV : Engineering Geology
Theory paper XVI : Statistical Geology and Computer Applications in Geology

Practical paper XIII : Mining Geology
Practical paper XIV : Geochemistry
Practical paper XV : Engineering Geology
Practical paper XVI : Statistical Geology and Computer Applications in Geology

SEMESTER- I

THEORY PAPER I- MINERALOGY AND CRYSTALLOGRAPHY

Marks – 50

Total Periods – 40

UNIT –I

Silicate structures of minerals; physical and chemical properties of minerals.
(5 Periods)

UNIT – II

Structure, chemistry, alteration products, paragenesis and synthesis of the following group of rock- forming minerals- olivine, pyroxene, amphibole, mica, chlorite, feldspar, feldspathoids, garnet, epidote, silica, aluminosilicate, clay minerals, carbonate minerals and metallic oxides.
(10 Periods)

UNIT III

Birefringence, pleochroism and interference phenomena in minerals; extinction angles; optical indicatrix; concept of uniaxial and biaxial indicatrix; dispersion in minerals; optical anomalies; and optical accessories like quartz, mica and gypsum plate; universal stage.
(10 Periods)

UNIT- IV

Concept of symmetry; space lattice and point groups; 32 classes of symmetry.
(10 Periods)

UNIT –V

Goniometry, twinning and imperfections of the crystals; X- rays and its application in crystallography
(5 Periods)

PRACTICAL PAPER I- MINERALOGY AND CRYSTALLOGRAPHY

Marks- 25

Total 6 Periods/ week

Study of rock- forming minerals in hand specimen; study of rock- forming minerals in thin sections; optical properties of uniaxial and biaxial minerals- pleochroism, extinction, interference colours and optical angle; calculation of chemical formula of minerals and its plotting; twin laws; anorthite content of plagioclases; 32 classes of crystal symmetry; method of plotting of poles by stereographic projections.

RECOMMENDED BOOKS

1. Dana:- Elements of Mineralogy
2. Deer, Howie and Zussman:- Rock forming minerals
3. Kerr:- Optical mineralogy
4. Winchell:- Elements of Optical Mineralogy (Part I, II and III)
5. Wahlstrom:- Optical crystallography
6. Phillipps:- An introduction to crystallography
7. Barry and Mason:- Mineralogy
8. Klein and Hubert(1993) :- Manual of mineralogy
9. Spear, F. S. (1993) :- Mineralogical phase equilibria and Pressure- Temperature- Time paths
10. Phillipps, W. R. and Guffen, D. T. (1986) :- Optical mineralogy

THEORY PAPER II- IGNEOUS PETROLOGY

Marks- 50

Total Periods- 40

UNIT- I

Physics of magma generation in crust and mantle; nature of magma; factors affecting magma and evolution of magma.

(5 Periods)

UNIT- II

Phase equilibrium of unicomponent, binary; ternary and quaternary silicate systems; its relation to magma genesis and crystallization in the light of modern experimental works.

(15 Periods)

UNIT- III

Criteria for classification of the igneous rocks; CIPW- norms, Niggli values, Zavaritski number, IUGS classification.

(8 Periods)

UNIT- IV

Major and trace elements and isotopic composition of igneous rocks; origin of monomineralic rocks, alkaline rocks, carbonatites, pegmatites and lamprophyres; ophiolites.

(12 Periods)

UNIT- V

Crystallization of basaltic and granitic magmas; basaltic associations of ocean basins and continental tholeiitic basalts.

(10 Periods)

PRACTICAL PAPER II- IGNEOUS PETROLOGY

Marks 25

Total 6 Periods/ week

Study of igneous rocks in hand specimen; study of igneous rocks in thin sections; structures and textures in igneous rocks; calculation of CIPW norms and Niggli values; plotting of chemical data on different variation diagrams for evaluation of magma and rock types; field mapping in basaltic terrain; preparation of igneous rock slides.

RECOMMENDED BOOKS

1. Barth:- Theoretical Petrology
2. Bowen:- Evolution of Igneous Rocks
3. Turner and Verhoogan:- Igneous and Metamorphic Petrology
4. Carmichael, Turner and Verhoogan:- Igneous Petrology
5. Hatch, Wells and Wells:- Petrology of Igneous rocks
6. Brain:- Igneous Petrology
7. Best (1986) :- Igneous Petrology
8. Mc Berney (1993) :- Igneous Petrology
9. Bose (1997) :- Igneous Petrology

THEORY PAPER III- METAMORPHIC PETROLOGY

Marks- 50

Total Periods- 40

UNIT I

Types of metamorphism; characteristics of metamorphic reactions; mineralogical phase rule of closed and open systems; application of phase rule.

(5 Periods)

UNIT II

Role of temperature, pressure and fluids in metamorphism; a detailed description of each facies of low pressure, medium to high pressure and very high pressure with special reference to characteristic metamorphic zones and subfacies; nature of metamorphic reactions and pressure- temperature conditions of metamorphism.

(10 Periods)

UNIT III

Progressive, contact and regional metamorphism of igneous and sedimentary rocks; cataclastic metamorphism.

(10 Periods)

UNIT IV

Metamorphic differentiation; anatexis and origin of migmatites; regional metamorphism and pair metamorphic belts in reference to plate tectonics.

(10 Periods)

UNIT V

Pressure – temperature – time paths; ultra high temperature, ultra high pressure and ocean floor metamorphism.

(5 Periods)

PRCTICAL PAPER III- METAMORPHIC PETROLOGY

Marks- 25

(Total 6 Periods/ week)

Study of metamorphic rocks in hand specimen; study of metamorphic rocks in thin sections; structures and textures in metamorphic rocks; interpretation of reaction texture; plotting of chemical data on ACF, AKF and AFM diagrams; preparation of metamorphic rock slides.

RECOMMENDED BOOKS

1. Harker:- Metamorphism
2. Turner:- metamorphic Petrology
3. Winkler:- Petrogenesis of metamorphic rocks
4. Miashiro:- Metamorphism and metamorphic rocks
5. Turner and verhoogan:- Igneous and Metamorphic Petrology
6. Philipots(1972):- Igneous and Metamorphic Petrology
7. Bucher and Feg (1994):- Petrogenesis of metamorphic rocks

THEORY PAPER IV- SEDIMENTARY PETROLOGY

Marks 50

Total Periods- 40

UNIT I

Earth surface system- liberation and flux of sediments; processes of transport and formation of sedimentary rocks; classification of sedimentary rocks; sedimentary textures and structures.

(8 Periods)

UNIT II

Sedimentary environments and facies; continental, alluvial- fluvial, lacustrine, desert- aeolian and glacial sedimentary systems.

(8 Periods)

UNIT III

Evolution of sedimentary basins- tectonics and sedimentation.

(8 Periods)

UNIT IV

Deep sea basins; clastic petrofacies; palaeoclimate and palaeoenvironment analysis.

(8 Periods)

UNIT V

Diagenesis of mudstones, sandstones and carbonate rocks.

(8 Periods)

PRACTICAL PAPER IV- SEDIMENTARY PETROLOGY

Marks- 25

Total 6 Periods/ week

Study of sedimentary rocks in hand specimen; study of sedimentary rocks in thin section; study of primary, secondary and biogenic sedimentary structures in hand specimen; aerial photographs and field exercises related to palaeocurrent data from different environments; exercises related to analysis and interpretation of depositional sedimentary environments; determination of porosity in clastic and carbonate rocks; staining and mineral identification in carbonate rocks; detailed study of diagenetic features in thin sections; preparation of thin section of sedimentary rocks.

RECOMMENDED BOOKS

1. Allen, J.R.L.(1985):- Principles of physical sedimentation
2. Nichols, G.(1999):- Sedimentology and Stratigraphy
3. Reading, H.G.(1996):- Sedimentary environments
4. Reineck, H.R. and Singh, I.B. (1980):- Depositional sedimentary environments
5. Miall, A.D.(2000):- Principles of sedimentary basin analysis
6. Eincele,G.(1992):- Sedimentary basins
7. Pomerol, C.(1982):- The Cenozoic Era: Tertiary and Quaternary
8. Tucker,M.(1988): - Techniques in sedimentology
9. Blatt, H.(1982): - Sedimentology

SEMESTER- II

THEORY PAPER V- STRATIGRAPHY AND PALAEOONTOLOGY

Marks- 50

Total Periods- 40

UNIT I

Stratigraphic procedures; concept of lithofacies and biofacies; stratigraphic correlation; study of standard stratigraphic code.

(4 Periods)

UNIT II

The problem of basement; classification and correlation of Precambrian crystalline rocks of India; stratigraphy and correlation of the Proterozoic rocks of India; Precambrian – Cambrian boundary problem.

(9 Periods)

UNIT III

Palaeozoic of Himalayas; stratigraphy and correlation of the Gondwana rocks; Mesozoics of Peninsular India; Problems of Cretaceous- Eocene boundary of India; Tertiary rocks of India and their correlation; Quaternary stratigraphy of India; Neogene- Quaternary boundary problem.

(9 Periods)

UNIT IV

Origin and evolution of life; fossils and their uses, collection, preparation, preservation and maintenance of palaeontological record; microfossils; application of micropalaeontology in palaeoecology and correlation; principles of palaeobotany

(9 Periods)

UNIT V

Hard- part morphology, classification, evolution, stratigraphic range and distribution of fishes, dinosaurs, equidae and hominidae group; Gondwana and Inter- trapean floras; echnofossils

(9 Periods)

PRACTICAL PAPER V- STATIGRAPHY AND PALAEOONTOLOGY

Marks 25

Total 6 Periods/ week

Exercises on stratigraphic classification and correlation; study of palaeogeographic maps of all the geological periods; plotting of rock formations on maps; study of important genera of invertebrate, vertebrate and plant fossils; study of fossils in thin sections; study of microfossils.

RECOMMENDED BOOKS

Krishnan, M. S. :- Geology of India and Burma
Wadia, D.N. :- Geology of India
Ravindrakumar: - historical Geology
Pascoe, E.M.: - Manual Of Geology of India and Burma, Vol. I, II and III.
Dunbar and Rogers: - Principles of Stratigraphy
Krumbein and Sloss: - Stratigraphy and Sedimentation
Willey, M. J.: - Stratigraphic principles and practice
Naqui and Rodgers: - Precambrian Stratigraphy of India
Swinerton:- Outlines of Palaeontology
Moore, Lalicker and Higher: - Invertebrate Palaeontology

Remer : - Invertebrate Palaeontology
Shrock and Twenhofel: - Principles of Invertebrate Palaeontology
Arnold: - Introduction to Palaeontology
Lahmann and Hillmer: - Fossil Invertebrates
Glaessner: - Principles of Micropalaeontology

THEORY PAPER VI- STRUCTURAL GEOLOGY AND TECTONICS
Marks 50 **Periods- 40**

UNIT I

Mechanical principles and properties of rocks and their controlling factors; theory of rock failure; concept of stress and strain; two dimensional strain and stress analysis; types of stress and strain ellipses and ellipsoids; their properties and geological significance; strain marks in naturally deformed rocks.

(8 Periods)

UNIT II

Folds-

Geometric classification of folds; mechanics of folding and buckling; folding in shear zones; distribution of strains in folds; structural analysis in terrain with multiple deformation.

(8 Periods)

UNIT III

Faults-

Causes and dynamics of faulting; strike- slip faults; normal faults; overthrust and nappe
Fractures and joints- their nomenclature; age relationship; origin and significance

(8 Periods)

UNIT IV

Fundamental concepts of geotectonics; recent advances, pros and cons; dynamic evolution of continental and oceanic crust; tectonics of Precambrian orogenic belts of India; tectonic framework of India; seismicity in India

(8 Periods)

UNIT V

Formation of mountain roots; anatomy of the orogenic belts; structure and origin of the Alpine- Himalayan belt, Appalachian- Caledonian belt, Andes and North- American Cordillera.

(8 Periods)

PAPER VI- STRUCTURAL GEOLOGY AND TECTONICS
Marks – 25 **Total 6 Periods/ week**

Relation of structural- geology problems by orthographic and stereographic methods; completion of outcrops; drawing of structural sections and interpretation of geological maps; graphical solutions.

RECOMMENDED BOOKS

1. Badgley, P.C. (1965): - Structure and Tectonics
2. Ramsay, S.G. (1967): - Folding and Fracturing of Rocks
3. Davis, G.R. (1984): - Structural Geology of Rocks and Region
4. Price, N.J. and Cosgrove, J.W. (1990): - Analysis of Geological Structures
5. Bayly, B.(1992): - Mechanics in Structural Geology
6. Moors, E. and Taiss, R.J. (1995) Tectonics
7. Keary, P and Vine, F.J. (1990); - Global Tectonics
8. Valdiya, K.S. (1998): - Dynamic Himalaya

THEORY PAPER VII- REMOTE SENSING AND GEOMORPHOLOGY
Marks 50 **Periods- 40**

UNIT I

General idea about electromagnetic spectrum; aerial photographs and their geometry; photogrammetry; recent advancement and application

(8 Periods)

UNIT II

Satellite remote sensing; global and Indian space missions; different satellite exploration programs and their characteristics: LANDSAT, METEOSAT, SEASAT, SPOT and IRS.

(8 Periods)

UNIT III

Interpretation and digital processing techniques; use of remote sensing in groundwater exploration, petroleum exploration; use of satellite images in monitoring natural hazards and environment.

(8 Periods)

UNIT IV

Dynamics of geomorphology; geomorphic processes and resulting landforms and their discrimination on photos and images; morphometric analysis and modeling

(8 Periods)

UNIT V

Geomorphological mapping based on genesis of landforms; terrain evaluation for strategic purpose; principles and applications of Geographic Information System.

(8 Periods)

PRACTICAL PAPER VII- REMOTE SENSING AND GEOMORPHOLOGY
Marks- 25 **Total 6Periods/ week**

Study and nature of aerial photographs resolution, mosaics, symbols, gully, pattern and drainage analysis, image parallax; determination of scale, height, dip, slope, vertical exaggeration and image distortion; detailed study of imageries

RECOMMENDED BOOKS

1. Miller (1961); - Photogeology
2. Sabbins (1985): - Remote Sensing- Principles and Applications
3. Ray (1969): - Aerial Photographs in Geological Interpretations
4. Drury (1987): - Image Interpretation in Geology
5. Moffitt and Mikhail (1980): - Photogrammetry
6. Lillesand and Kieffer (1987): - Remote Sensing and Image Interpretation
7. Pandey (1987) Principles and Application of Photogeology

8. Gupta (1990): - Remote Sensing Geology
9. Thornbury : - Principles in Geomorphology
10. Summerfield (2000): - Geomorphology and Global Tectonics

THEORY PAPER VIII-ORE GEOLOGY, INSTRUMENTATION AND ANALYTICAL TECHNIQUES
Marks- 50 **Periods- 40**

UNIT I

Modern concept of ore genesis; spatial and temporal distribution of ore deposits- a global perspective; ore deposits and plate tectonics

Mode of occurrence of ore bodies- morphology and relation of host rocks; texture, paragenesis and zoning of ores and their significance; concept of ore-bearing fluids, their origin and migration; wall- rock alteration; structural, physiochemical and stratigraphic control of ore localization.

(8 Periods)

UNIT II

Chemical composition of ores- bulk chemistry, trace elements; REE and isotopes (stable and radiogenic); organic matter in ores and their significance.

(8 Periods)

UNIT III

Orthomagmatic ores of mafic- ultramafic associations - diamond in Kimberlite; REE in carbonatites; Ti- V ores; chromite and PGE; Ni ores; Cyprus type Cu- Zn ores of silicic igneous rocks- Kenua type Fe- P; pegmatites; gneisses; skarns

Ore of sedimentary affiliation- chemical and clastic sedimentation; stratiform and stratabound ores deposits(Mn, Fe, non- ferrous ores); places

Ores of metamorphic affiliation- metamorphism of ores; metamorphogenic ores

Ore related to weathering- laterite, bauxite, Ni/ Au laterite

(8 Periods)

UNIT IV

Sampling and sampling preparation; thin section and polished section making; dissolution procedures in geological and environmental samples; sample etching; staining and modal count techniques.

(8 Periods)

UNIT V

Principles and geological application of cathodeluminescence, thermoluminescence; atomic absorption spectroscopy; inductively coupled plasma- atomic emission spectrometry, x- ray fluorescence spectrometry, scanning and transmission electron microscopy; electron- probe microanalysis; x- ray diffractometry; thermal ionization and gas source mass spectrometry.

(8 Periods)

PRACTICAL PAPER VIII-ORE GEOLOGY, INSTRUMENTATION AND ANALYTICAL TECHNIQUES

Marks 25

Total 6Periods/ week

Megascopic study of structures and fabrics of different ores and their associations; mineralogical and textural studies of common ore minerals under petrological microscope and ore microscope; petrological study of other

industrial and non- metallic minerals; exercises on the determination of reflectivity and microhardness of common ore minerals.

Determination of elemental composition of minerals and rocks by flame photometer and atomic absorption spectrometer; preparation of thin sections and polished sections; etching and staining.

RECOMMENDED BOOKS

1. Craig and Vaughan (1981): - Ore Petrography and Mineralogy
2. Evans (1993): - Ore Geology and Industrial Minerals
3. Sawkins (1984): - Metal Deposits in Relation to Plate Tectonics
4. Klemm and Schneider (1977): - Time and Strata- bound Deposits
5. Toiling (1981): - Economic Geology and Geotectonics

SEMESTER III

THEORY PAPER IX- HYDROGEOLOGY

MARKS- 50

PERIODS- 40

UNIT I

Ground water, origin, types, importance, occurrence, reservoirs and movement; renewable and non- renewable groundwater resources; hydrologic properties of rocks: porosity; permeability; specific yield; specific retention, hydraulic conductivity, transmissivity, storage coefficient

(8 Periods)

UNIT II

Groundwater quality, estimation of parameters, groundwater quality map of India; hydrographs; water table contour maps; hydrostratigraphic units

(8 Periods)

UNIT III

Well hydraulics: confined, unconfined, steady, unsteady and radial flow; water level fluctuations; causative factors and their measurements; methods of pumping test and analysis of test data; evaluation of aquifer parameters

(8 Periods)

UNIT IV

Artificial recharge of groundwater; problem of over exploitation of groundwater; groundwater legislation; water management in rural and urban areas, salt water intrusion in coastal aquifers; remedial measures.

(8 Periods)

UNIT V

Surface and sub surface geophysical and geological methods of groundwater exploration; hydrogeomorphic mapping using various Remote Sensing techniques; radio isotopes in hydrogeological studies.

(8 Periods)

PRACTICAL PAPER IX- HYDROLOGY

MARKS – 25

6 PERIODS / WEEK

Delineation of hydrological balance on water – table contour maps and estimation of permeability; analysis of hydrographs; geophysical and geological methods of ground water exploration; pumping test; time drawdown and time recovery tests and evaluation of aquifer parameters; step drawdown tests; estimation of TDS using resistivity and SP logs; electric resistivity sounding for delineation of fresh and saline aquifers

BOOKS RECOMMENDED

Todd, D.K. (1980) Groundwater Hydrology
 Davies, S.N and De Wiest, R.J.M (1966) Hydrogeology
 Freeze, R.A. and Cherry, J.A. (1971) Groundwater
 Fetter, C.W. (1990) Applied Hydrology
 Raghunath, N.M. (1982) Groundwater
 Karanth, K.R. (1987) Groundwater assessment, Development and Management
 Alley, W.M. (1983) Regional groundwater quality
 Subramaniam, V.(2000) Water

THEORY PAPER X – FUEL GEOLOGY

MARKS –50

PERIODS- 40

UNIT I

Petroleum- its composition and different fractions; origin, nature and migration (primary and secondary)
 Of oil and gas; transformation of organic matter into kerogene; surface and subsurface occurrence of petroleum and gas.

(8 Periods)

UNIT II

Characteristics of reservoir rocks and traps (structural, stratigraphic and correlation);
 Prospecting for oil and gas, drilling and logging procedures; oil-bearing basins of India; geology of the productive oil fields of India; position of oil and natural gas in India; future prospects and the economic scenario.

(8 Periods)

UNIT III

Coal- Definition and origin of kerogen and coal; sedimentology of coal bearing strata; rank, grade and type of coal; Indian and International classifications of coal; macroscopic ingredients and microscopic constituents; concept of maceral and microlithotypes.

(8 Periods)

UNIT IV

Chemical characterization : proximate and ultimate analysis; coal petrology and its application in solving industrial and geological problems; preparation of coal for industrial purposes; coal carbonization (coke manufacture) coal gasification and coal hydrogenation
 Coal bed – methane : a new energy resource.

(8 Periods)

UNIT V

Atomic fuel- Mode of occurrence and association of atomic minerals in nature; atomic minerals as source of energy; methods of prospecting and productive geological horizons in India; nuclear power stations of the country and future prospects; atomic fuels and environment.

(8 Periods)

PRACTICAL PAPER X- FUEL GEOLOGY

MARKS –25

6 PERIODS/ WEEK

Megascopic characterization of banded coals; proximate analysis of coals; completion of outcrops in the given maps and calculation of coal reserves; microscopic examination of polished coal pellets (identification of macerals in coal)

Megascopic and microscopic study of cores and well cuttings; study of geological maps and sections of important oilfields of India; calculation of reserves

BOOKS RECOMMENDED

Taylor, G.H., Teichmüller, M., Davis, A., Diessel, C.F.K. and others (1998) Organic Petrology
Selley, R.C. (1998) Elements of Petroleum Geology
Levenson
Chandra, D., Singh, R.M and Singh, M.P. (2000) Textbook of Coal
Singh, M.P. (1998) Coal and Organic Petrology
Stach, E, Macknowsky, M.T.H; Taylor, H.H and others (1982) Stach's Textbook of Coal Petrology
Durrance, E.M. (1986) Radioactivity in Geology: Principles and Applications

THEORY PAPER XI- GEOPHYSICAL EXPLORATION

MARKS- 50

PERIODS- 40

UNIT I

Variation of gravity over the surface of the earth; principles of gravimeters; gravity field surveys; various types of corrections applied to gravity data; preparation of gravity anomaly maps and their interpretation in terms of shape, size and depth.

(8 Periods)

UNIT II

Geomagnetic field of the earth; magnetic properties of rocks; working principles of magnetometers; field surveys and data reductions; quantitative interpretation; magnetic anomalies due to single pole, dipole; introduction to aeromagnetic surveys

(8 Periods)

UNIT III

Resistivity methods; basic principles; various types of electrode configurations; field procedure profiling and sounding.

(8 Periods)

UNIT IV

Seismic methods; fundamental principles of wave propagation; reflection and refraction surveys; concept of seismic channels and multi-channel recording of seismic data; End-on and split spread shooting techniques; CDP method of data acquisition; sorting; gather; stacking and record section; seismic velocity and interpretation of seismic data

(8 Periods)

UNIT V

Application in mineral and petroleum exploration; description of bore-hole environment; brief outline of various well-logging techniques; principles of electrical logging and its application in petroleum; groundwater and mineral exploration; prospecting for radioactive minerals.

(8 Periods)

PRACTICAL PAPER XI- GEOPHYSICAL EXPLORATION

MARKS -25

6 PERIODS /WEEK

Interpretation of geophysical logs for geological purpose; application of geophysical data in mineral exploration- gravity data, magnetic data, electrical data; utility of seismic reflection data in recognition of subsurface structures; interpretation of seismic data.

BOOKS RECOMMENDED

Sharma, P.V. (1986) Geophysical Methods in Geology

Dobrin, M.B.(1976) Introduction to Geophysical Prospecting
Paransis, D.S.(1975) Principles of Applied Geophysics
Stanislave,M.(1984) Introduction to Applied Geophysics
Rao, M.B.R. Outlines of Geophysical Prospecting Manual for Geologists

THEORY PAPER XII- ENVIRONMENTAL GEOLOGY

MARKS –50

PERIODS- 40

UNIT I

Concepts and principles of environmental geology; Time scales of global changes in the ecosystem and climate; impact of circulation in atmosphere and oceans on climate, rain fall and agriculture
(8Periods)

UNIT II

Carbon dioxide in atmosphere; limestone deposits in the geological sequences; records of palaeotemperatures in ice- cores of glaciers; global warming caused by CO₂ increase in present atmosphere due to indiscrete exploitation of fossil fuels; volcanic eruptions and afforestation.
(8Periods)

UNIT III

Natural hazards like floods, landslides, earthquakes, river and coastal erosion – preventive and precautionary measures
Impact assessment of mining; dumping of ores; mine waste and fly ash
(8Periods)

UNIT IV

Impact assessment of degradation and contamination of surface water and groundwater quality due to industrialization and urbanization; organic and inorganic contamination of groundwater and its remedial measures; water logging problems due to the indiscrete construction of canals, reservoirs and dams
(8Periods)

UNIT V

Soil profiles and soil quality degradation due to irrigation; use of fertilizers and pesticides and remedial measures
Environmental protection – legislative measures in India
(8Periods)

PRACTICAL PAPER XII- ENVIRONMENTAL GEOLOGY

MARKS –25

6 PERIODS / WEEK

Study of seismic and flood prone in India; analysis of alkalinity, acidity, pH, and conductivity (electrical) in water section; classification of groundwater for use in drinking, irrigation and industrial purposes; presentation of chemical analysis ; data and plotting ; chemical classification diagram; evaluation of environmental impact of air pollution and groundwater pollution; deforestation; landslides; cultivation and building construction

BOOKS RECOMMENDED

Keller, E.A. (1978) Environmental Geology
Buyant, E.(1985) Natural Hazards
Valdiya, K.S. (1987) Environmental Geology- Indian Context
Patwardhan, A.M. (1999) The Dynamic Earth System

Bell, F.G. (1999) Geological Hazards
Smith, K. (1992) Environmental Hazards
Subramaniam, V. (2001) Textbook in Environmental Hazards
Tank, R.W. Focus on Environmental Hazards
Strahler and Strahler Environmental Geology
Truk and Truk Environmental Geology

SEMESTER – IV

THEORY PAPER XIII- MINING GEOLOGY

MARKS –50

PERIODS- 40

UNIT I

Subsidence and the support of mine excavation; timber treatment; methods of breaking rocks; drilling blast holes; explosives used in mining; blasting practices

(8 Periods)

UNIT II

Shaft sinking; drifting; cross cutting; winzing; stoping; room and pillaring; top –slicing; sub- level caving and block caving; mine drainage; ventilation; illumination

(8 Periods)

UNIT III

Alluvial, open- pit and under ground mining methods; safety works; mine organization and operation; mine hazards: mine inundation, fire and rock burst.

(8 Periods)

UNIT IV

Factors in evaluating a mineral deposit; mine examination; theory and methods of sampling; sampling calculations; recoverable values

(8 Periods)

UNIT V

Cost of mining; future costs and profits; life of mine; present value of mine and its determination by compound interest and Hoskold formula methods; amortisation; calculations pertaining to valuation of mines of uniform and non uniform annual income; sale of mineral products; metal prices and mine valuation; valuation of prospects: developed mines and working mines; valuation report.

(8 Periods)

PRACTICAL PAPER XIII- MINING GEOLOGY

MARKS- 25

6 PERIODS/WEEK

Determination and evaluation of ores in mines; different sampling calculations; recoverable values ; cost of mining; future cost and profits; life of mine; determination of present value of mines; cross section of mines with the help of available data.

BOOKS RECOMMENDED

Young, G.J.- Elements of Mining
Lewis, R.A. and Clark, G.A. - Elements of Mining

Arogyaswami- Mining Geology
Mckinstry,H.E. - Mining Geology
Sheryanthov,L.- Mining of Mineral deposits

THEORY PAPER XIV- GEOCHEMISTRY

MARKS – 50

PERIODS- 40

UNIT I

Origin and abundance of elements in the earth and its constituents.

Atomic structure and properties of elements in the periodic table; special properties of transition and rare earth elements; geochemical classification of elements

(8 Periods)

UNIT II

Radiogenic isotopes; radioactive decay schemes of V-Pb, Sm- Nd, Rb- Sr, K- Ar and growth of daughter isotopes; radioactive dating of single minerals and whole rocks; stable isotopes: nature, abundance and fractionation

(8 Periods)

UNIT III

Laws of thermodynamics; concept of free energy; activity; fugacity and equilibrium constant; thermodynamics of ideal, non- ideal and dilute solutions

(8 Periods)

UNIT IV

Principles of ionic substitution in minerals; element partitioning in mineral/ rock formation and concept of simple distribution coefficients and exchange reaction distribution coefficients; element partitioning in mineral assemblages and its use in the pressure- temperature estimation

(8 Periods)

UNIT V

Chemistry of natural waters; mineral stability in Eh- pH diagram; rock weathering and soil formation; elemental mobility in surface environment ; concept of geochemical- biogeochemical cycling and global climate

(8 Periods)

PRACTICAL PAPER XIV- GEOCHEMISTRY

MARKS 25

6 PERIODS/WEEK

Preparation and interpretation of geochemical maps; Rock/ sediments/ water/ soil analysis;

BOOKS RECOMMENDED

Mason, B.and Moore, C.B. (1991) Introduction to Geochemistry
Faure,G.(1986) Principles of Isotope Geology
Hoefs,J.(1980) Stable Isotope Geochemistry
Marshall, C.P. and Fairbridge,R.W. (1999) Encyclopedia of Geochemistry
Govett,G.J.S. (1983) Handbook of Exploration Geochemistry

THEORY PAPER XV- ENGINEERING GEOLOGY

MARKS- 50

PERIODS-40

UNIT I

Role of engineering geology in civil construction and mining industry; various stages of engineering geological investigation for civil projects; engineering properties of rocks; rock discontinuities; physical characters of building stones; metal and concrete aggregates

(8 Periods)

UNIT II

Geological consideration for evaluation of dams and reservoirs sites; types of dams; dam foundation rock problems

(8 Periods)

UNIT III

Geotechnical evaluation of tunnels; types of tunnels; methods of tunneling; classification of ground for tunneling purposes; roads and airfields

(8 Periods)

UNIT IV

Mass movements with special emphasis on landslides and causes of hill slopes instability; slumps and settlements; precautionary measures

(8 Periods)

UNIT V

Earthquake and seismicity; seismic zones of India; Aseismic design of building; influence of geological causes for maihaps and failures of engineering structures; beach engineering

(8 Periods)

PRACTICAL PAPER XV- ENGINEERNG GEOLOGY

MARKS 25

6 PERIODS/WEEK

Suitable dam sites, selection for sites of tunnels; seismic zones in India; compressional strength , tensile strength of rock and building materials;p hardness test; roughness test; magnetic, seismic and electrical resistivity methods of exploration as applied to engineering investigations; interpretation of drilling data for engineering construction.

BOOKS RECOMMENDED

Krynine and Judd- Principles of Engineering Geology
Richeny,J.E.- Elements of Engineering Geology
Lagget- Geology and Engineering
Trefethen, Joseph- Geology of Engineers
Gupte,R.- Text book of Engineering Geology

THEORY PAPER XVI- STATISTICAL GEOLOGY AND COMPUTER APPLICATIONS IN GEOLOGY

MARKS- 50

PERIODS- 40

UNIT I

Statistical methods; mean; median and mode; standard deviation; skewness and kurtosis and their interrelationship; scatter diagrams; frequency distribution; histogram; coefficient of correlation and regression
(8 Periods)

UNIT II

Nature of geological data; scales of measurement; concepts and types of models in geology; sample population; population distribution and population density function and their properties
(8 Periods)

UNIT III

Distribution of sample variance and chi square distribution; probability; testing normal distribution; students 't' test, 'f' test; confidence interval, analysis; calculation of variance- covariance, simple linear models; cluster analysis
(8 Periods)

UNIT IX

Computer fundamentals; introduction to Wordstar, Lotus, Debase and Autocad; MS- Windows operating system, office automation tools, internet and intranet
(8 Periods)

UNIT V

Application to petrological and geochemical problems; use of standard software analysis and interpretation of geological data; writing of simple programs to apply some elementary statistical techniques to geological data; GIS
(8 Periods)

PRACTICAL PAPER XVI- STATISTICAL GEOLOGY AND COMPUTER APPLICATIONS IN GEOLOGY

MARKS 25

6 PERIODS/WEEK

Interpretation of histograms, cumulative curves, scatter diagrams; problems on the student 't' test, chi square test. mean; median and mode; standard deviation; skewness and kurtosis and their interrelationship. Application of computer to petrological and geochemical problems

BOOKS RECOMMENDED

J.C.Davis- Statistics and data analysis in Geology
B.L.Raktoe and J.J. Hubert- Basic applied Statistics
P.Mukhopadhyay- Mathematical Statistics

